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THE GORDIACEA OF CERTAIN AMERICAN
COLLECTIONS.

WITH PARTICULAR REFERENCE TO THE NORTH AMERICAN FAUNA.

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WITH FIFTEEN PLATES.

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No. 3. — *The Gordiacea of certain American Collections with particular Reference to the North American Fauna.* By THOMAS H. MONTGOMERY, JR.

It has been the intention of the author to pursue certain anatomical studies on *Gordius* and its allies, but this object could not be immediately carried out owing to lack of material, and also to the difficulty encountered in determining the American species. Accordingly it seemed advisable to describe the American species systematically before entering upon an anatomical study of them. It is very apparent that the North American Fauna is very rich in species of *Gordiacea*, and yet the investigation of these interesting forms has been almost wholly neglected by American zoölogists, Joseph Leidy being thus far almost our only writer upon them; and more species are known from South than from North America.

The material for this study was mainly derived from three collections. The Leidy collection, which is the property of the University of Pennsylvania, is the richest of these, and contains some of Leidy's types; my thanks are due to Dr. Charles W. Stiles of the Smithsonian Institution for having kindly forwarded this collection. I would express my obligations to Dr. Alexander Agassiz for permission to examine the excellent collection of the Museum of Comparative Zoölogy at Harvard; and to Dr. W. M. Woodworth for his trouble in sending me this collection. My thanks are further due to Dr. Stiles for specimens from his own and from the Smithsonian collection; and for other specimens to the following gentlemen: Prof. E. G. Conklin, University of Pennsylvania; Prof. Thos. H. Morgan, Bryn Mawr College; Mr. E. G. Vanatta, Academy of Natural Sciences, Philadelphia; and to Mr. Satterthwaite of Westtown, Pa. Further, I would express my thanks to the curators of the Academy of Natural Sciences, Philadelphia, for the opportunity to examine the specimens in this collection. In a previous paper, to appear in April, 1898, in Spengel's "Zool. Jahrbücher," I described two new exotic species from American collections.

Certain of the new species here described were based upon the examination of a single specimen, but of most of them several individuals were studied. It is, in my opinion, less adducive to confusion of nomenclature to preliminarily separate aberrant forms, even though only single specimens are known, than to class them all under one name. This group of worms is difficult of study, the external specific characters are few, and it appears that it is a group in which many of the species are in process of transformation, judging from their amount of variability. Then there are sometimes sexual differences, as well as differences at various times of life. Bearing these points in view, I have laid particular stress upon the following systematic characters: the superficial markings of the cuticle, which have been shown by Villot to present exceedingly valuable and reliable characters, though even the surface of the cuticle is in many forms subject to individual variation; the form of the posterior end in both sexes; and, though this is not as reliable as the preceding character, the form of the anterior end. The presence of median dorsal or ventral grooves along the surface of the body is a less reliable character, and still less so is the coloration. The males are more easily determined than the females; the form of the tail lobes in *Gordius* and the presence or absence of hairs or spines in their neighborhood are of much importance; but in the genus *Chordodes* the form of the posterior end of the male is much more uniform than in the males of the former genus.

A historical review of the previous researches upon the American species will be followed by the descriptions of the species examined.

A. HISTORICAL REVIEW.

1847. Creplin described *Chordodes parasitus*, n. sp., from a Brazilian *Acanthoditis*, but his brief description is altogether insufficient for purposes of identification.

1849. Gay described from Valparaiso, Chile, a *Gordius* (*G. chilensis*) as follows: "Gordius gracilis, cinereo-fuscus, obscurus; capite nigro . . . es de color pardo morenuseo oscuro, con la estremidad anterior del cuerpo ó la region cefálica negra; en los manchos la porcion posterior se bifurca mucho." I agree with Camerano ('90) that this diagnosis is wholly insufficient.

1850. Leidy briefly refers a *Gordius* seen by him to the European *G. aquaticus*.

1851. Leidy describes *G. varius*, n. sp., which is distinguished from *G. aquaticus* in that "the caudal extremity of the female is trifurcated, while that of the European species is blunt. The length is from 4 to 12 inches. Of this species there are several varieties from different localities, which may upon further examination prove to be distinct species. . . . A second species of Gordius was obtained by Professor Baird from a spring in Essex County, New York. It is much more delicate than the former, and from 5 to 7 inches long. The female caudal extremity is blunt. The male caudal extremity is bifurcate and fringed with peculiar epidermoid appendages. For this second species the name *Gordius lineatus* was proposed." In the same year Diesing writes of *G. chordodes*, n. sp.: "Corpus longissimum teretiusculum crassum rigidum, fusco-brunneum. Caput apice rotundatum. . . . Habitaculum. Acanthodis glabrata: in cavo abdominis, in Brasilia (Beschke). Specimen identicum femineum ex aqua in Brasilia hausit (Natterer)." Diesing's species is not sufficiently characterized.

1853. Baird mentions two new species from North America, of which the first is a good species: *G. platyura*, n. sp.: "Body of a uniform dull white color, quite smooth, with a depressed line on one side throughout its whole length, obscurely ringed at unequal distances, narrower at the anterior extremity and terminating in a broad, flattish tail, which is slightly bifid. Length of animal 32 inches, breadth of middle of body about $\frac{1}{2}$ a line; tail 1 line broad. Jamaica?" *G. fasciatus*, n. sp.: "Epidermis granulated. . . . Body smooth, skin prettily shagreened with very fine lines crossing each other in opposite directions, of a light color banded with broad patches of dark brown. Anterior extremity smaller than posterior, and roughened with raised circular ridges, which extend for about three lines, and as well as posterior extremity of a very dark color, almost black. Length $11\frac{1}{2}$ inches, breadth about 1 millimeter." This was a female from North America. I regard this description of *G. fasciatus* as wholly inadequate for purposes of identification, and on this account judge that Römer ('96) is in error in placing it as a synonyme of *G. aquaticus* Linn. Leidy ('53) mentions *Gordii* of a milk-white color as very common in grasshoppers in the vicinity of Philadelphia.

1855. Möbins gives a good description of *Chordodes pilosus*, n. sp. from Venezuela; though he confused the head end with the posterior extremity: length 212 mm., "er . . . nahm aber während neun Tagen, die er noch im Wasser, sich träge bewegend, lebte, um 259 mm. zu, so dass seine Länge, als er todt war, 471 mm. betrug"; tail end swollen,

cloacal opening large, circular. Head laterally compressed, somewhat pointed; cuticle with irregular prominences, which are figured. Or, in the words of his own diagnosis: "Corpus nigrum verrucosum, medio cylindricum, utrinque attenuatum depressumque, linea ventrali et dorsali, quarum parti caudali fasciculi pilorum insiti. Caput ellipsoideum, concavitate frontali. Extremitas caudalis trigona, apice rotundata." This is a good species.

1856. Leidy gives a much fuller description of his *G. varius*. He also describes *G. robustus*, n. sp., and places synonymous with it *G. seta* Müll., and *G. lineatus* Leidy.

1857. The same author mentions a collection of 48 *Gordii*, 525 miles west of Fort Riley, Kansas.

1858. Leidy notes the occurrence of an embryo of *G. varius* in *Lumbriculus limosus*.

1861. Diesing regards *G. platyurus* and *fasciatus* Baird as good species; as also *G. varius* Leidy, with which he considers synonymous the "*G. aquaticus*" of Leidy, '51. He considers Leidy's *lineatus* and *robustus* as doubtful synonymes of *G. seta* Müll. (*aquaticus* Linn.). Diesing also describes *G. subspiralis*, n. sp.: "Corpus maris brunneum, feminae antrorsum attenuatum, laete brunneum, nitidum, iridescens. Caput annulo obscure brunneo cinctum. Extremitas caudalis maris subspiralis crucibus furcae terminalis divergentibus, incurvatis, laevibus, plica membranacea semilunari ad basin junctis, feminae obtusa, subcompressa. . . . In palude cum Siredonibus, copiose, in territorio Kansas (Hammond)."

1866. Schneider regards *G. varius* Leidy as a possible synonyme of *G. gratianopolensis* Charvet (*G. tricuspидatus* Meissn.).

1874. Villot regards the following as good species: *G. lineatus*, *robustus*, and *varius* of Leidy; *G. subspiralis* and *G. chordodes* of Diesing; and *G. chilensis* Blanchard. He describes the following new species from America:—*G. aeneus*, n. sp.: "Extrémité antérieure tronquée, légèrement renflée. Ouverture ano-génitale du mâle entourée d'un anneau brun. Lobes bien développés, séparés par un assez large intervalle. Brun bronzé. (Les jeunes individus sont d'un blanc jaunâtre uniforme.) Epiderme divisé en losanges par un réseau de lignes saillantes obliquement croisées"; from Cumana, Venezuela. *G. reticulatus*, n. sp.: "Extrémité antérieure terminée en pointe aiguë. Diamètre du corps allant en grossissant de l'extrémité antérieure à l'extrémité postérieure, qui se termine en point tronquée. Ouverture ano-génitale large. Brun marron. Une bande dorsale et une bande ventrale d'un brun plus

foncé. Epiderme aréolé. Aréoles formant un réseau à mailles irrégulières et inégales, ayant en moyenne 10 millièmes de millimètre. Une bordure simple de petites papilles autour des aréoles. . . . Californie." *G. prismaticus*, n. sp.: "Grêle et aplati. Extrémité postérieure bilobée. Brun pâle. Epiderme aréolé. Aréoles prismatiques et hexagonales, ayant environ 10 millièmes de millimètre de haut sur 6 millièmes de millimètre de large. Quelques papilles très-petites et très-espacées. . . . Nouvelle-Grenade. Prairie du plateau de Bogota, par 2,600 mètres d'altitude." He also describes *G. deshayesi*, n. sp. from Venezuela.

1879. Weyenbergh gives inadequate descriptions of the following new species from South America: *G. tenuis*, *dubius*, and *acridiorum*. In the same year Leidy gives a good description of his *G. robustus*, based on specimens from Maryland.

1881. Oerley regards the following American forms as good species: *G. fasciatus* and *platyurus* Baird, *G. æneus* and *trilobus* of Villot.

1885. Jeffrey-Bell mentions *G. verrucosus* Baird, from Vera Paz, Guatemala, and from Costa Rica.

1887. Villot considers *G. subspiralis* Dies. as a synonyme of *G. aquaticus* Duj.; and adds: "Il se peut aussi que le *Gordius robustus* de Leidy et mon *Gordius reticulatus*, établis sur des échantillons recueillis en Amérique, ne soient que des synonymes du *Gordius violaceus* de Baird.

1890. Camerano considers as doubtful species *G. chilensis* Gay, *tenuis* and *dubius* Weyenbergh, and *parasitus* (Creplin), and considers that *G. acridiorum* Weyenbergh is either a *Mermis* or *Filaria*. According to him Villot's three species, *G. æneus*, *deshayesi*, and *prismaticus*, are tenable, and he gives a description of a female specimen of *G. æneus*.

1892. Camerano describes a male of *G. paranensis*, n. sp. from Palmeira (Parana).

1893. The same writer says of the occurrence of *G. verrucosus* Baird in North America, as reported by Jeffrey-Bell, "Je crois qu'il serait nécessaire de faire une révision des spécimens américains rapportées a cette espèce." He also mentions a specimen of *G. varius* Leidy, from Monterey, Mexico, and states "mais on peut douter . . . que ces caractères soient suffisants pour distinguer le *G. varius* du *G. tricuspidatus* L. Dufour (*G. gratianopolensis* Diesing, Villot)." Janda describes a male of *Chordodes brasiliensis*, n. sp. from Brazil.

1894. Goeldi mentions the occurrence of the preceding species in Brazil. Camerano describes the following new species from Paraguay

and the Argentine Republic: *G. alfredi*, *danielis*, and *peraccæ*; and also describes female specimens of *prismaticus* Villot and *paranensis* Camer.

1895. Camerano describes males of *G. latastei*, n. sp. from Santiago, Chile. Römer describes *Chordodes variopapillatus*, n. sp. from Brazil; a female of *G. violaceus* Baird from Arizona, a male of *G. aquaticus* Linn. from Brazil, and a female of the same species from Chili.

1896. Römer, in his excellent revision of the *Gordiacea*, regards the following American species as tenable: *G. platyurus* Baird, *æneus* Villot, *paranensis* Camer., *Chordodes brasiliensis* Janda, *Chordodes pilosus* Möbius, and *C. variopapillatus* Römer; the following as synonymes of *G. aquaticus* Linn.: *robustus* and *lineatus* Leidy, *fasciatus* Baird, *subspiralis* Diesing; *G. reticulatus* Villot as a synonyme of *G. violaceus* Baird; and the following species as untenable: *G. chilensis* Blanchard, *prismaticus* Villot, *Chordodes parasitus* Creplin, *G. parasitus* Diesing, *G. deshayesi* Villot, and *G. verrucosus* Baird. According to Römer, *Gordius varius* Leidy becomes *Chordodes varius* Leidy. In this year Camerano describes *Chordodes balzani*, n. sp. from Bolivia.

1897. Camerano ('97^a) mentions specimens of *G. obesus* Camer. from Santiago and Gualaquiza, and of *Chordodes bowieri* Villot from Gualaquiza; and also describes males of *C. festæ*, n. sp. from Cuenca. In a second paper ('97^b) he describes *C. talensis*, n. sp. from Bolivia; he notes *G. alfredi* Camer. from Tala, *G. varius* Leidy from Bolivia, and *C. peraccæ* from Tucuman; and he further describes male and female specimens of *C. brasiliensis* Janda from S. Lorenzo and Tala.

CRITIQUE.

There is considerable confusion in regard to the tenability of certain of the preceding American species, mainly due to insufficient diagnoses, so that it is necessary to relinquish some of them. Those species which are insufficiently described, and hence untenable, are in my opinion the following: *Chordodes parasitus* Creplin ('47), *Gordius chilensis* Gay (Blanchard) ('49), *G. aquaticus* Leidy ('50), *G. chordodes* Diesing ('51), *G. tenuis*, *dubius*, and *acridiorum* of Weyenbergh ('79). *G. fasciatus* Baird ('53) seems also inadequately described. The description of *G. subspiralis* Diesing is sufficient for identification, though in the descriptive part of this paper we shall find it to be possibly synonymous with *G. aquaticus robustus* (Leidy). Leidy's description ('51) of his *G. lineatus* is really insufficient; but this species is nevertheless tenable, since I had opportunity to examine the type specimens, and have found them to differ from any other species of *Gordius*. *G. reticulatus* Villot ('74)

seems to be also untenable, though it may correspond to *G. violaceus* Baird, as is supposed by Villot ('87) and by Römer ('96); Villot's *G. deshayesi*, *æneus*, and *prismaticus* seem to me to be also doubtful, though the last two may be preliminarily retained, since Camerano has found further specimens which appear to agree with them. Römer has given good reasons to show that *G. verrucosus* Baird is too poorly described to be tenable; and there is the greater reason for relinquishing this species, since Camerano ('93) has described under the same name a form which appears to be a *Chordodes*; hence this name must be dropped from the American fauna, if not altogether from the nomenclature of the *Gordiacea*. Leidy's ('56, '79) descriptions of his *G. robustus* are sufficient for purposes of identification, though in the descriptive part of our paper I shall rank this form as a subspecies of the European *G. aquaticus* Linn.

There remain then the following species from the American continents which appear tenable: *Gordius varius* Leidy, *G. robustus* Leidy, *G. lineatus* Leidy, *G. platyurus* Baird, *G. æneus* Villot, *G. paranensis* Camer., *G. alfredi* Camer., *G. danielis* Camer., *G. latastei* Camer., *G. obesus* Camer.; *Chordodes pilosus* Möbius, *C. brasiliensis* Janda, *C. peracca* Camer., *C. variopapillatus* Römer, *C. balzani* Camer., *C. bouvieri* Villot, *C. festæ* Camer., and *C. talensis* Camer. Thus all of the species described by Camerano appear tenable, but since most of his descriptions are unaccompanied by figures the reidentification of them is rendered very difficult. The following species are to be regarded as doubtful, if not even needing elimination: *G. fasciatus* Baird, *G. prismaticus* Villot, *G. deshayesi* Villot, and *G. verrucosus* Baird.

It seems to be questionable whether the specimens of *G. violaceus* Baird and *G. aquaticus* Linn., described by Römer from Arizona and South America respectively, really belong to these species; but this point will be more fully criticised in our description of *G. aquaticus robustus* (Leidy), and of the two new species, *G. platycephalus* and *G. densareolatus*.

In the following descriptions, unless otherwise specified, it will be understood that the cuticle has been examined on surface preparations and sections in Canada balsam.

B. DESCRIPTIONS OF THE SPECIES EXAMINED.

1. *Gordius aquaticus robustus* (Leidy).

Plates 1, 2, and Figs. 13, 16-19 of Plate 3.

G. robustus Leidy, '56, '79.*G. subspiralis* Diesing, '61.*G. robustus* Leidy, Villot, '74.? *G. violaceus* Baird, Villot, '87.? *G. aquaticus* Linn., Römer, '95, '96.(Leidy's '79, *types*; Leidy coll. no. 5056, Coningo, Maryland.)

Form. The male more slender than the female, in both sexes the body of approximately the same diameter in its whole extent. Head end (Figs. 2, 6, 9, 10, 11, 17) usually obtuse, especially in the male (Figs. 2, 6, 10), sometimes somewhat conical in the female (Fig. 17). Occasionally a slight neck constriction is present. Usually no median longitudinal grooves are to be seen. In some of the larger specimens, especially the females, the whole body is very much flattened, and these are apparently individuals which have discharged their ova. The posterior end of the female is obtusely truncated (Figs. 7, 8), with a faint vertical groove on the terminal aspect; the cloacal aperture is terminal, and lies in this groove. Figures 9, 10, show depression on the terminal face of the head.

The posterior end of the male is spirally inrolled (a character of the males of all the *Gordiacea* examined), and is furcate. The tail lobes (Figs. 1, 3-5, 19) are short, nearly cylindrical on cross section except that they are somewhat concave on their medio-ventral surface, and divergent. The cloacal opening is round and situated anterior to the point of bifurcation of the lobes. On the ventral side of the anterior ends of the tail lobes is situated a more or less crescent-shaped transverse cuticular ridge, with posteriorly directed concave edge. This sharp cuticular ridge is postcloacal. Short branching hairs occur on the surface of the tail lobes as elsewhere on the surface of the body, but no spicules; and there is no particular arrangement of the hairs in the vicinity of the cloacal aperture.

Cuticle (Figs. 12, 13, 16). True areoles are absent. In most of the specimens, and especially well marked in the males, the surface of the cuticle is marked by very fine intersecting lines, and, at greater distances apart, by broader intersecting raised ridges, which are strictly parallel to the finer lines which lie in the rhombic spaces demarcated by them, and which themselves are formed of bundles of fine lines. These larger ridges are seen with low powers of magnification, but higher powers are necessary in order to detect the system of finer lines which lie between them. On the cuticle, especially abundant at the ends of the body, are also seen short, thick, and branching hairs.

Color. Variable according to age, and apparently also according to locality. The body varies from a yellowish white to a yellowish brown, or a light chocolate-brown; the males are usually darker than the females. The tip of the head is white, and behind it a broad reddish brown ring is to be seen in most specimens (not present in some females from Kansas). In all the females a more or less intense reddish brown ring immediately encircles the cloacal aperture; and in some specimens there is a narrower, lighter ring outside of and separated from the former. In the male a similar dark ring encircles the cloacal opening, at a little distance from it; and a spot of deep brown may lie at the posterior edge of this ring: the postcloacal cuticular ridge is brown, its posterior edge a much darker reddish brown.

Dimensions. Largest male, 655 μ m.; greatest diameter, 1.3 mm. Largest female, length 705 μ m.; greatest diameter, 1.9 mm. The males are more slender and usually somewhat shorter than the females. The individuals from the western United States (Montana, Kansas) averaged considerably longer than any eastern specimens examined.

Comparison. This species has been placed by me as a subspecies of *G. aquaticus* Linn., since the differences do not warrant ranking it as a separate species. It differs from the true European *aquaticus* in these points: the presence of a dark ring around the female cloacal aperture, the absence of a row of hairs around the male cloacal aperture, and the absence of white spots ("helle Flecken") on the cuticle.

Special Diagnostic Characters. The approximately equal diameter of the whole body, with the obtuse truncation of the two ends; the absence of true areoles, and the presence of short hairs on the cuticle; the presence of a transverse postcloacal cuticular ridge in the male, the posterior edge of which is darkest in color, and the absence of a line of hairs around the cloacal aperture.

Geographical Distribution. I have seen specimens from Maryland, Massachusetts, District of Columbia, New York, Maine, Pennsylvania, Montana, and Kansas; and Leidy mentions its occurrence at the Bay of Fundy. The specimens of "*G. aquaticus*" mentioned by Römer ('95), from South America, are probably specimens of our subspecies.

2. *G. aquaticus difficilis*, n. subsp.

Figs. 14, 15, Plate 3.

(*Type*: 1 male, Leidy coll. 5100, Roan Mt., N. Carolina.)

Form. General form as in the preceding subspecies, cylindrical with the greatest diameter posteriorly, head (Fig. 14) rounded. Posterior end (Fig. 15) as in the preceding, but a parabolic line of hairs curves around the cloacal aperture, the posterior ends of this line of hairs situated upon the latero-ventral surfaces of the tail lobes, at about the plane of anterior bifurcation of the latter.

Cuticle. At the tip of the head there are small, round or polygonal prominences or areolæ, of slight elevation, and of a deeper brown color than the sur-

rounding portions of the cuticle. These are densely massed together at the tip of the head, and a few isolated areolæ occur along the sides of the body near the head. Similar areolæ, but of larger size, are found also on the dorso-lateral surfaces of the tail lobes. The cuticle is elsewhere marked by minute intersecting lines, much as in the preceding species; when studied in alcohol the cuticle appears to be areolated in its whole extent, but sections show that the apparent areolæ are nothing but slight elevations between the bundles of intersecting lines, the supposed areolæ themselves being striated by fine lines.

Color. Remarkably iridescent. Whole body a light chocolate-brown color, the tip of the head the same. There is a dark ring immediately around the cloacal aperture. The whole surface of the postcloacal cuticular ridge is of a uniform brown color, without darker posterior edge.

Dimensions. Length, 70 mm.; greatest diameter, .5 mm.

Comparison. This form resembles, but seems to be distinct from *G. aquaticus robustus*. It differs from the latter as follows: in the presence of areolæ on the head and tail lobes; in the circumcloacal line of hairs; in the uniform dark brown color of the postcloacal cuticular ridge; in the absence of a dark ring around the neck, and of a white tip to the head. These characters seem to warrant placing it, preliminarily at least, as a new subspecies.

3. *G. lineatus* Leidy.

Figs. 20-31, Plate 4.

G. lineatus Leidy, '51.

G. robustus Leidy, '56.

? *G. seta* Müll., Diesing, '61.

G. lineatus Leidy, Villot, '74.

G. aquaticus Linn., Römer, '96.

(*Types*: Leidy coll. 5008, Essex County, New York, 1851.)

Form. Head end (Figs. 20, 21) rounded, not constricted from the body; body cylindrical, somewhat narrowed anteriorly. Median grooves absent. Posterior end (Figs. 22, 23, 28) not swollen, obtusely truncated in the female.

Males somewhat more slender than the female, and somewhat flattened. Tail lobes (Figs. 24-26) rather long and divergent, their distal ends curved inwards (ventrad). Cloacal opening elongate, above the lobes. Cuticular spicules of an elongate conical form on the median surfaces of the tail lobes, though not on the distal ends of the lobes. Two rows of rather long branching hairs on the ventral surface of the body; one row on each side of the median line, each row extending from a little in front of the cloacal opening to a little behind the point of bifurcation of the tail lobes; the hairs are longest in the middle of each line. Tail lobes concave on their medio-ventral surfaces.

Cuticle (Figs. 29-31). Areolated, areolæ closely opposed without intervening spaces; rectangular or polygonal in outline, frequently elongated in the direction of the body axis, and with a tendency to group themselves into

longitudinal rows which form ridges on the body surface. The areolæ vary considerably in form and size.

Color. A pale transparent yellowish white, the female of a deeper buff color. In the female the cloacal opening is immediately surrounded by a narrow, reddish brown ring.

Dimensions. Length of largest male, 278 mm. ; greatest diameter, .6 mm. Length of largest female, 283 mm. ; greatest diameter, .8 mm. The females are a little longer and broader than the males, but both sexes are very slender.

Comparison. This species stands closest to *G. violaceus* Baird, but differs from it in the form of the tail lobes, and in the arrangement of the spicules on them, as well as by its very slender form.

Particular Diagnostic Characters. Very slender and short, of a pale yellowish or buff color. Areolæ small, close together, with a tendency to form longitudinal ridges. A line of long hairs to each side of the cloacal aperture in the male, and spicules on the tail lobes.

Geographical Distribution. New York, Maryland, and one specimen secured by me in a spring in Chester County, Pennsylvania. Leidy's type specimens were also found in a spring.

4. *G. densareolatus*, n. sp.

Figs. 32-33, Plate 4; Plate 5.

(*Types*: Leidy coll. 5063, Fort Bridger, Wyoming.)

Form of Female. Head end (Figs. 34, 35) conical, terminally rounded, the terminal portion slightly constricted off; mouth opening terminal. Anterior portion of the body narrower than the middle and posterior portions. With more or less pronounced dorsal and ventral median lines. Posterior end (Figs. 38, 39) slightly widened horizontally, obtusely truncated, with a shallow vertical groove on its posterior aspect, in the middle of which the cloacal opening lies.

Form of Male. Generally similar to but more slender than the female. The tail lobes (Figs. 36, 37) are short, thick, asymmetrical, and divergent. The cloacal aperture is small, circular, and immediately enveloped by a dark ring; it is situated anterior to the tail lobes, on the ventral surface of the body. On the antero-ventral surface of the tail lobes is an integumentary (not purely cuticular) ridge of slight elevation, the two arms of this ridge converging and joining just behind the cloacal aperture. The ventro-median surfaces of the tail lobes are concave. From the cloacal aperture, and embracing it, there extends cephalad, for a distance about equal to the length of the shorter tail lobe, a comparatively wide groove on the ventral surface of the body; at each antero-lateral edge of this groove lies a rounded prominence or ridge. The ventro-median surfaces of the tail lobes and the postcloacal integumentary ridge are covered with short conical cuticular spicules, which extend cephalad to each side of the cloacal aperture.

Cuticle (Figs. 32, 33). Areolated; the areolæ variable in size and form, usually elongate-oval or irregularly pentagonal in outline. Their longitudinal axis is usually nearly perpendicular to that of the body, and they tend to produce transverse rows or chains, in each of which rows some of the areolæ are confluent. Narrow, shallow grooves separate neighboring parallel rows of areolæ; and beneath the areolæ a system of fine intersecting lines is seen. No interareolar bristles or hairs are present.

Color. In the female (three specimens examined) the extreme tip of the head is white, this is followed by a light buff ring, and immediately behind the latter a broad transverse reddish brown ring. The cloacal aperture is immediately surrounded by a thin black ring, and around the latter is a much broader circular area of a reddish brown color. The rest of the body is a deep yellowish brown in one specimen; a light chocolate color in the other specimen. Color of the male (a single specimen) similar to that of the female, but darker, a deep chocolate color; a nearly black ring surrounds the cloacal opening, while the postcloacal integumentary ridge is slightly lighter than the surrounding parts.

Dimensions. Male, length, 290 mm.; greatest diameter, 1.1 mm. Female, length of largest specimen, 395 mm.; greatest diameter, 1.7 mm.

Comparison. This species is quite similar to the European *G. tatrensis* Janda, but differs from it in that all the areolæ are of a dark color and there are no groups of areoles forming white spots; and in the male the tail lobes are shorter and thicker, and there is no "knorriges, glattes, dreiwandiges Höfchen" around the cloacal aperture, such as is described by Janda ('93). It also differs from *G. violaceus* Baird in the manner of distribution of the spicules on the tail lobes, and in the confluence of the areolæ. It is however most closely allied to *G. platycephalus*, n. sp.; these resemblances will be discussed under the heading of that species.

Especial Diagnostic Characters. The dense arrangement of the irregular areolæ, which have a tendency to produce transverse rows, and the tendency to confluence of the areoles; the comparatively robust form of the body; the short, thick tail lobes in the male, with the conical spines on their ventral surface, the obscure postcloacal integumentary ridge, and the ventral depression within which the cloacal aperture lies.

Geographical Distribution. The type specimens (2 males, 1 female) are from Fort Bridger, Wyoming; and another female from South Montana (coll. Acad. Nat. Sci. Philadelphia).

5. *G. platycephalus*, n. sp.

Plate 6; Figs. 46-49, Plate 7.

(Type of female: coll. Acad. Nat. Sci. Phila., Guatemala. Type of male: coll. Acad. Nat. Sci. Phila., South Montana.)

Form of Female. Anterior portion of the body attenuated and flattened in all specimens, and the head constricted from the body. The head (Figs. 42, b,

c, 45) is of slightly greater diameter than the part of the body immediately preceding, tip of the head rounded or truncated; in one specimen a groove on the ventral surface of the head. Body either flattened or cylindrical, with deep dorsal and ventral median grooves. In all females except one the posterior end (Figs. 42 a, 43, 44) of the body is somewhat constricted for a distance of about 6 mm., but the extreme posterior end is usually swollen, somewhat knob-shaped; on lateral view this end appears obliquely truncated, the posterior end of the body has a vertical groove on its terminal aspect, and the cloacal aperture is not exactly terminal, but somewhat ventral.

In the male the anterior portion (Fig. 40) of the body is not attenuated, though it is slightly flattened horizontally; the head is elongate-oval in outline, of greater diameter than the part immediately preceding, and is terminally rounded. The body like that of the female, but more slender. Tail lobes (Fig. 41) rather slender and long, asymmetrical, their distal ends curved ventro-mediad; they are nearly cylindrical, flattened only on the median surface. The large, elongate cloacal aperture is situated on the ventral surface of the body, and separated from the anterior point of bifurcation of the tail lobes by a distance equal to half the length of the tail lobes. This aperture does not lie in a groove; nor do spicules nor long hairs occur near it or on the tail lobes, but only minute, short hairs.

Cuticle (Figs. 46-49). Areolated; the areolæ slightly smaller than those of *G. densareolatus*, more or less of the same size, and either irregularly polygonal or somewhat elongate in outline, and then usually elongated in the direction of the transverse axis of the body. The areolæ are usually well separated from one another, except in the median line, and show no tendency to produce confluent rows. Small interareolar groups of small bristles occur in most of the individuals, these bristles varying in number and form.

Color. Brown, varying in shade, but never very intense; tip of head lighter, and a more or less pronounced dark ring around the neck. In the male an obscure brown ring immediately surrounds the cloacal aperture.

Dimensions. Length of male, 216 mm.; greatest diameter, 1 mm. Length of largest female, 335 mm.; greatest diameter, 1.4 mm.

Comparison. In the configuration of the cuticle this species is most closely allied to *G. violaceus* Baird, and to *G. densareolatus* mihi. The males of these three species are very different, however, in regard to the arrangement of the spicules on the posterior end, such spicules being absent in *platycephalus*. This character does not serve to distinguish the females of these species however, though the flattening of the anterior portion of the body is diagnostic of *platycephalus*. But I am wholly at a loss to classify one female from Montana in the collection of the Acad. Nat. Sci.: it has the flattened head of *platycephalus*, with the confluent areolæ of *densareolatus*; its color is a deep buff, with a narrow black ring immediately around the mouth, but with no dark ring around the neck; the shape of the posterior end and the deep median grooves of the body resemble *platycephalus*, so that on the whole I should be inclined to consider it as *platycephalus*. But might not this specimen be a hybrid be-

tween these two species? Though the females of *violaceus*, *densareolatus*, and *platycephalus* are so similar, the males are nevertheless very different in regard to the form of their posterior ends, so that these species may be regarded as genetically related, and we must consider that the course of modification which they have undergone has influenced the males more than the females. This view of the question cannot be regarded as bizarre, since in other groups of animals also the males are in some cases far more dissimilar than the females.

Especial Diagnostic Characters. The flattening of the anterior end, and the constriction of the head from the body; the slight enlargement of the posterior end in the female; the absence of spicules on the tail lobes in the male; the presence of small, rounded-polygonal cuticular areoles, which are as a rule well separated from one another.

Geographical Distribution. Guatemala, South Montana, Pennsylvania, Bridger Basin, Fort Laramie. 1 male and 7 females examined.

6. *G. platyurus* Baird.

Figs. 50-52, Plate 7.

G. platyura Baird, '53.

G. platyurus Baird, Diesing, '61.

G. platyurus Baird, Villot, '74.

G. platyurus Baird, Oerley, '81.

G. platyurus Baird, Römer, '96.

(1 female examined: Leidy coll. 5096.)

Form. Very massive, flattened dorso-ventrally, with broad dorsal and ventral grooves, which do not extend quite to the posterior end. Head end (Fig. 52) conical. Largest diameter posteriorly. The posterior end (Fig. 51) is dorso-ventrally flattened, expanded, wider than the preceding portion of the body, spatulate in form, with shallow dorsal and ventral depressions. The cloacal aperture is terminal.

Cuticle (Fig. 50). With fine intersecting lines, much as in *G. aquaticus* Linn. Here and there bundles of elevated lines are demarcated from the finer lines, and these bundles, which are parallel to the finer lines, delineate rhomboid-shaped spaces.

Color. A light yellowish buff, somewhat iridescent. Extreme tip of head white, behind which is a faint brownish ring. Posterior tip of the body a light yellowish white.

Dimensions. Length, 540 mm.; greatest diameter of body, 2.4 mm.; greatest transverse diameter of tail, 2.3 mm.

No locality is marked for this specimen; the only other specimen known, the type in the British Museum, is labelled "Jamaica?" so that it is not yet proved that this species is American. It seems to me probable that it does not come from the North American continent, since otherwise there would probably be numerous examples of this large species extant. Its massive form and the spatulate shape of the posterior end are good diagnostic characters.

7. *G. leidyi*, n. sp.

Figs. 53-55, Plate 7; Figs. 56-59, Plate 8.

(1 female, type: Leidy coll. 5089, no data.)

Form. Head (Fig. 53) conically pointed, obtusely rounded at the tip, where the mouth opening is terminal and forms a slight projection. Body cylindrical, with deep dorsal and ventral grooves, the ventral one not quite in the median plane. Posterior portions of the body for a distance of about 12 mm. slightly flattened horizontally, and of slightly less diameter than the middle of the body. The dorsal groove of the head extends nearly from the head to the posterior end of the body; the ventral groove ends about 5 mm. in front of the posterior end. Posterior end (Figs. 56-58) truncated, almost vertically. Cloacal aperture (Fig. 57) terminal, nearly in the centre of the disk which forms the distal face of the posterior end. This aperture is placed upon a round, elevated papilla, the latter sunk in a depression of the distal face of the body. To each side of the cloacal papilla is a short vertical, elevated integumentary ridge, while below the depression in which the cloacal papilla lies is a transverse ridge. On the dorsal side of the posterior end (Fig. 56) is a nearly U-shaped integumentary fold, to each side of which is an elongated pit or depression. The latter pits lie respectively on the dorso-lateral sides of the posterior end of the body, and extend posteriorly as far as the vertical tegumentary ridges which form the lateral boundaries of the depression in which the cloacal papilla is situated. The distal end of the dorsal U-shaped fold forms a transverse ridge bounding dorsally the depression in which the cloacal papilla lies. The dorso-median groove of the body extends on the surface of this fold to the posterior end of the latter, the groove being broadest at this point. Thus the posterior end of the body is vertically truncated, with a concave distal face; in the centre of this depression, situated on the summit of a slightly elevated papilla, lies the cloacal aperture; the outlines of this terminal concavity of the body form nearly a square, its boundary being two short vertical ridges, a transverse ventral ridge, and a transverse dorsal ridge which is the distal end of a U-shaped fold of the integument situated on the dorsal side of the end of the body. These relations are somewhat complicated, and may be best understood by reference to the Figures 56-58.

Cuticle. Areolated; areolæ (Figs. 54, 55) only slightly elevated, on cross section they show no hyaline summit, irregularly polygonal in outline; they are usually elongated in the line of the transverse axis of the body, and show a tendency to form short and interrupted rows or chains, contiguous areoles in such rows being confluent. The areolæ are separated only by narrow spaces. The cuticle is also marked by intersecting elevated lines (Fig. 59) placed at considerable but varying distances apart, these lines being easily visible on the alcoholic specimen. Interareolar bristles are absent.

Color. Head end light yellowish brown, the rest of the body a deep yellowish brown color, with an obscure dusky brown ring on the head. In the

median line of the dorsal groove of the body are two narrow, parallel stripes of an intense reddish brown color, which are in contact with one another in the median line. In the ventral median groove of the body are two parallel stripes of about the same color as those in the dorsal groove, but with this difference, that they are separated from one another by a distance about equal to the diameter of either of the lines, and that the two ventral stripes are of not quite the same diameter. Both the dorsal and ventral stripes of color disappear near the two ends of the body.

Dimensions. Length, 295 mm.; greatest diameter, 1.5 mm.

This species is sharply distinguished from all other species of the genus known to me by the peculiar form of the posterior end, and by the colored stripes lying within the median grooves of the body. Unfortunately the locality is not given for the specimen. I have named it in honor of the pioneer student of the American *Gordiacea*, Joseph Leidy.

3. *G. agassizi*, n. sp.

Figs. 63-66, Plate 9.

(Type, 1 male: Harvard collection no. 296, Sandwich Isl.)

Form. Body much flattened dorso-ventrally, without well marked median grooves; the body is flattened in such a way that the dorsal side is rounded, the ventral side concave, so that a cross section would show the body to be somewhat sickle-shaped. Head end likewise dorso-ventrally flattened. The particular characteristic of this species, however, is that the broad plane of the neck does not coincide with the broad plane of the head, but is nearly vertical to it (Fig. 63). Thus the flattening of the head and of the body lies in approximately the same plane, while the neck region (for a distance of about .9 mm.) is twisted around through an angle of nearly 180 degrees, and hence the broad plane of the neck is nearly vertical to that of the head and to that of the body. Hence in viewing the head end either from the dorsal (Fig. 63) or the ventral aspect, the neck appears like a short slender thread. This relation has probably been produced by a torsion of the neck region through an angle of nearly 180 degrees. The outline of the head, viewed from the flattened surface, has somewhat the shape of an unbarbed arrow-head, broadest posteriorly and with rounded tip; the mouth opening is large, transversely elongated, and situated at the termino-ventral margin of the head. The neck inserts itself along an elevated ridge which circumscribes the posterior portion of the head. On the dorsal surface of the head (Fig. 63), to each side of the median line, are found just behind this elevated ridge a number of small ridges which are parallel to one another (i. e. those on the same side of the ridge are parallel), and these are obliquely disposed to the large ridge. These relations are difficult to describe, but may be understood by comparing the figure.

The tail lobes (Figs. 65, 66) are bent ventrad, nearly at right angles to the posterior end of the body region proper. Each tail lobe is much flattened laterally, and is very short; it is somewhat rounded on the lateral, and corre-

spondingly concave on the median side. Viewed from the side (Fig. 65) each shows a more or less conical outline, broadest at the proximal end, rounded at the distal end. The dorso-median margin is slightly thickened. The flattened planes of the two lobes are not parallel, their dorso-median margins being much closer together than the ventro-median; the proximal ends of their dorso-median margins are in contact, while the ventro-median margins are farthest apart proximately (Fig. 66). The median plane between the two lobes is vertical to the flattened plane of the posterior end of the body proper. The tail lobes may well be termed leaf-shaped.

Cuticle (examined in alcohol only, since it seemed inadvisable to section the single specimen at hand). The surface (Fig. 64) viewed with low powers of the microscope, shows very plainly a system of deep intersecting lines, between which lie slightly elevated areolæ of rhombic or rhomboid outline. There are necessarily two systems of parallel lines; and in one of these two systems the lines tend to occur in pairs.

Color. The body is a uniform rufous-brown color, the tail lobes somewhat lighter. The mouth region of the head is yellowish, behind which follows a zone of a nearly black color; the posterior portion of the head is but little darker in color than the body.

Dimensions. Length, 158 mm.; greatest diameter of head, 1 mm.; greatest diameter of body, 1.5 mm.

Comparison. This species may be very sharply distinguished from any other Gordiacean yet described, by the torsion of the neck through an angle of nearly half a circle, and by the extreme flattening of the tail lobes. It is the only species known from the Sandwich Islands.

9. *G. capitosulcatus*, n. sp.

Figs. 67-69, Plate 9; Fig. 70, Plate 10.

(*Type*, 1 male: Harvard coll. 1466 a, Cuba.)

Form. The body is dorso-ventrally slightly flattened, with slight dorsal and ventral median grooves. The head (Figs. 67, 69) is flattened laterally, higher than broad, and is separated from the body by a slight constriction (neck). The head has the greatest diameter at the anterior end, where it is obliquely truncated, the dorsal margin projecting slightly farther forwards than the ventral. The terminal aspect (Fig. 67) of the head is concave, the large mouth opening situated in the median line, nearer the ventral than the dorsal margin of the head. At each anterior dorso-lateral margin of the head is a ring-shaped prominence (Fig. 69), which surrounds a pit-like depression. It would be impossible to determine the structural significance of these pits without sectioning the head, but this was not permitted on the single specimen examined.

The tail lobes (Fig. 70) are slightly divergent; each is terminally rounded, nearly cylindrical on cross section, but concave on the median surface. The lobes are long and slender, and apparently bear no hairs or spicules. The

cloacal aperture is situated on the ventral surface of the body, a short distance in front of the point of union of the two lobes.

Cuticle (Fig. 68). With small elevated areoles, situated close together. The areoles are somewhat variable in size and form, but are mostly rounded-polygonal in outline. Their surface is not smooth, as in the other species of the genus examined by me, but with irregular short tubercles. Interareolar bristles are apparently absent.

Color. Pitch-black to the naked eye, but with a brownish tinge when viewed with the microscope. The margins of the ring-shaped prominences of the head are of a whitish color.

Dimensions. Length, 165 mm.; greatest diameter, 9 mm.

Special Diagnostic Characters. The presence of depressions on the anterior dorso-lateral margins of the head; the roughened surface of the areoles; the intense black color.

Comparison. This form differs from *G. violaceus*, *densareolatus*, and *platycephalus* by the roughened surface of the areoles, the coloration, and the presence of the pits on the head. It has no close resemblance to any of the species described by Camerano from South America, and on the whole appears to be a well defined species.

10. *G. paranensis* Camer.

Figs. 71-74, Plate 10.

G. paranensis Camerano, '92, '94.

G. paranensis Camer., Römer, '96.

(1 female, 5 males: Harvard coll. no. 1478, Casabianca, Chile.)

Form of Female. Body somewhat flattened dorso-ventrally, without well marked median grooves. Head conical, concave on the terminal aspect, mouth terminal; head not constricted from the body. Posterior end (Fig. 71) truncated, with a circular depression on its terminal aspect, in which the cloacal opening lies; this posterior end of the body is round on cross section, while the immediately preceding portion of the body is much flattened dorso-ventrally.

Form of Male. Body more slender than in the female, and with more or less well marked median grooves. In one male (Fig. 74) the head end is conical with rounded tip; in the others it is separated from the body by a slight constriction, and is terminally truncated, the terminal face concave (Fig. 73); on this terminal aspect of the head in one specimen is a vertical, median ridge, to each side of which is a depression. A conical and a truncate form of head being found in different specimens of this species would lead to the conclusion that the truncate form, in which the anterior aspect of the head is concave, is probably due to a muscular contraction of the tip of the head. The tail lobes (Fig. 72, *a*, *b*) are comparatively short and thick, flattened on their proximo-median surfaces as well as on their dorso-lateral surfaces.

Apparently neither hairs nor spicules occur in the vicinity of the lobes. At the anterior point of union of the tail lobes, on the ventral surface of the body, is situated a V-shaped ridge, each arm of which is placed on the ventro-median margin of the corresponding tail lobe, the two arms of the V converging, and joining at an angle cephalad at the anterior point of union of the tail lobes. Anterior to this ridge is situated a broad and deep depression. At the deepest part of this depression, i. e. in the medio-ventral line just anterior to the ridge described, is situated the cloacal aperture; this aperture lies on the summit of a slightly elevated papilla. The anterior margin of the depression which surrounds the cloacal papilla forms a sharp ledge, irregularly semicircular in outline (the opening of the semicircle directed caudad); this sharp ledge, forming the anterior and lateral margin of the cloacal depression, is not elevated above the level of that portion of the ventral surface of the body which lies anterior to the depression. Along this ledge are arranged a row of short, thick hairs. Accordingly, we find on the ventral surface of the posterior end of the male a narrow V-shaped ridge at the base of the tail lobes; anterior to this a large and deep depression, in the centre of the posterior part of which the cloacal papilla is situated; and the anterior and lateral boundary of this depression, formed by a nearly semicircular sharp ledge.

Cuticle. There are no arcoles, but a system of broad intersecting, oblique lines, between which are much finer intersecting lines. Short hairs also occur here and there, but sparsely. The cuticle is thus very similar to that of *G. aquaticus robustus* (Leidy).

Color. Body of a dull olive-brown color. Tip of the head yellowish white, the remainder of the head reddish brown, varying in shade. The posterior end of the female is yellowish; the pit in which the cloacal aperture lies is of a deep reddish brown color, there being thus a disk of this color immediately around the aperture. In the male the postcloacal cuticular ridge is reddish brown, its posterior edge black.

Dimensions. Length of female, 470 μ m.; greatest diameter, 1.8 mm. Length of largest male, 340 μ m.; greatest diameter, 1.3 mm.

Especial Diagnostic Characters. The presence of a postcloacal ridge in the male, and the presence of a sharp precloacal ledge which bounds the cloacal depression; the intersecting lines of the cuticle.

Comparison. These specimens seem to agree wholly with Camerano's description of the species. This form is most closely allied to *G. aquaticus robustus* (Leidy).

Geographical Distribution. Asuncion, Paraguay; Palmeira (Parana); Casablanca, Chile.

11. *G. violaceus* Baird.

Figs. 60-62, Plate 8; Figs. 75-77, Plate 11.

G. violaceus Baird, '53. (For the synonymy of descriptions of specimens from other localities than America, cf. Römer, '96.)

? *G. reticulatus* Villot, '74 (from California).

? *G. violaceus* Baird, Villot, '87.

? *G. violaceus* Baird, Römer, '95 (from Arizona).

? *G. violaceus* Baird, Römer, '96.

(1 female, Harvard coll. no. 1465, California; 1 female, Harvard coll. no. 1666 c, Cuba.)

Description of the Californian Specimen. Body cylindrical without median lines. Posterior and especially the anterior portions of the body somewhat narrower than the middle; head (Fig. 61) of a rounded conical form, not constricted from the body, mouth terminal. Posterior end (Fig. 60) of the same diameter as the immediately preceding portion of the body, obtusely rounded terminally; the small, round cloacal aperture is terminal. *Cuticle* (Fig. 62) areolated: the brownish areolæ vary somewhat in size, are irregularly polygonal, and do not form rows but are well separated from one another; a few small interareolar bristles are present. *Color*: a clear chocolate-brown, head paler, a deep reddish brown ring around the mouth. *Length*, 130 mm.; *greatest diameter*, 9 mm.

Description of the Cuban Specimen. Body nearly cylindrical, with dorsal and ventral median grooves. Head cylindrical, narrower than the portion of the body immediately preceding, terminally truncated (Fig. 76); this plane of truncation is slightly convex, the mouth situated in its centre. The anterior portion of the body is gradually attenuated, of less diameter than the middle portion. Posterior end of the body (Fig. 75) obliquely truncated, in that the dorsal margin projects farther caudad than does the ventral margin; the posterior end of the body is flattened on its ventral surface. In the medio-ventral line is a shallow narrow groove, which passes dorsad on the terminal aspect of the body, this groove being deepest at the dorso-terminal margin of the body. Within this groove lies the terminal cloacal aperture. *Cuticle* (Fig. 77) areolated: areolæ low, irregularly rounded in outline, smooth superficially, close together; the areolæ are very little darker than the inter-areolar spaces; between them lie thick, conical hairs, which are higher than the areolæ. *Color* a uniform grayish brown, head lighter; the mouth is surrounded by a narrow reddish brown ring, and the vertical groove at the posterior end of the body is also of this color. *Length*, 112 mm.; *greatest diameter*, 1 mm.

Comparison. There is some doubt in my mind whether these specimens should be attributed to *G. violaceus* Baird, but they certainly come closer to this species than to any other, and until further specimens are examined from these localities may best be placed under this species. But we know that *platycephalus* and *densareolatus* come very close to *violaceus* in the structure of the

cuticle, but differ markedly in the form and armature of the posterior end of the male; and so it may be that the males of these two specimens, when discovered, may also be found to differ from the males of *violaceus*. But it would be inadvisable to classify these two females as a new species until the males are known.

The Californian form agrees very closely with the *G. reticulatus* of Villot ('74), also from California, but the male of the latter is likewise unknown, so that *reticulatus* must still be regarded as a doubtful species. Villot ('87) and Römer ('95, '96) hold the view that *reticulatus* may be synonymous with *violaceus*. The males of specimens from all these localities must first be examined before we can decide whether the true *violaceus* really occurs in America, or whether a subspecies or different species, distinct also from *platyccephalus* and *densarcolatus* does not take its place. Hence these two doubtful female specimens from Cuba and California, may only preliminarily be placed under *violaceus*.

PARAGORDIUS, n. gen. (cf. the Appendix).

(Type of the genus: *Gordius varius* Leidy, '51, '56.)

Generic Characters. The cloaca in the adult female is remarkably long (Fig. 86), nearly half an inch in length, and the caudal ganglion (Fig. 79, *N. Gl.*) is in direct connection with the cloacal epithelium, and at no point with the epidermis. The male is characterized by the absence of a cloacal musculature (Fig. 78). The trilobation of the posterior end of the female (Figs. 88-90) possibly also furnishes a true generic character.

Thus *Paragordius* differs anatomically more widely from *Gordius* and *Chordodes*, than the last two do from each other; for in both of the last two the female cloaca is very short, usually a fraction of a millimeter, and the caudal ganglion is never in contact with the cloacal epithelium, and in these also the male always possesses a cloacal musculature (Fig. 18). I am inclined to suppose that the European *Gordius tricuspoidatus* (Dufour) (*G. gratianopolensis* Dies.) should be placed in this new genus, since its female has also a trilobation of the posterior end. But unless the latter species be found to show also the anatomical generic characters given above, it must be kept separate from *Paragordius*, since it is doubtful whether the mere trilobation of the posterior end constitutes a good generic character, for we find in the female of *G. tolosanus* Duj. a tendency to bilobation of the posterior end of the body. I have had no opportunity to examine *G. tricuspoidatus*, and find no description of the anatomical structures at issue, so that the generic position of this European species must still remain doubtful, though it certainly should not be placed under *Chordodes*, as Römer ('96) has done, since the male has the typical bilobation of the posterior end shown by all true *Gordii*. I quite agree with Janda ('93) that the shallow ventral groove on the posterior end of the males of *Chordodes* is one of the important characters of the genus, since I have found this typical form of the posterior end in all male *Chordodes* examined by me,

and it has been found characteristic for all the males of *Chordodes* which have been heretofore described. The characters of these three genera of *Gordiacea* may be compared as follows.

Gordius. Posterior end of the male bilobed, a cloacal musculature present; posterior end of the female rarely much swollen, never cleft (except in *G. tolosanus*, where it is deeply grooved rather than cleft); the caudal ganglion in the female not in contact with the cloacal epithelium, the cloaca very short; cuticula marked with intersecting lines or with low areolæ, never with high tubercles or papillæ, though frequently with short hairs or conical processes (spicules).

Chordodes. Posterior end of the male not bilobed, but only with a comparatively shallow groove on the ventral surface; posterior end of the female usually swollen, never cleft; the caudal ganglion in the female not in contact with the cloacal epithelium, the cloaca very short; the male with a special cloacal musculature; cuticle usually marked with high tubercles or papillæ, and apparently always with hyaline club-shaped processes, which are very different from the interareolar hairs of *Gordius*.

Paragordius. Posterior end of the male bilobed, no cloacal musculature; posterior end of the female trilobed; the caudal ganglion in the female is in contact with the cloacal epithelium, and the cloaca is long; cuticle as in *Gordius*, except that the papillæ are enveloped in a hyaline layer, which forms the external layer of the cuticle (Fig. 91, a).

These three genera appear to be very natural groups, and each is to be distinguished by the union of certain characters, rather than by the presence of any single character. Of the three, *Gordius* occupies an intermediate position, with relations on the one hand to *Chordodes*, on the other to *Paragordius*, though it shows the greater affinity to *Chordodes*; while there are no good characters in common between *Chordodes* and *Paragordius*. Thus *Gordius* might be regarded as the more primitive parent form, from which the others have differentiated; but I reserve a discussion of this point for a subsequent contribution.

The following preliminary note on the caudal ganglion of *Paragordius* (in the female) may be of anatomical interest. This ganglion lies in contact with the cloacal epithelium at the anterior point of bifurcation of the two lateral tail lobes (Fig. 79). The posterior margin of this ganglion forms a thin vertical lamina, which may be in contact with that portion of the epidermis lying between the two lateral lobes, but it certainly does not terminate in contact with the epidermis of the ventral surface of the body. The ventral nerve chord anterior to the caudal ganglion lies in the ventro-median line between the intestine and the longitudinal musculature of the body wall, as in both *Gordius* and *Chordodes*, as far as the latter genera have been examined. But there are certain small nerves which take their origin from the antero-dorsal margin of the caudal ganglion, and these nerves lie directly beneath the cloacal epithelium. These relations were studied on sections of two females; and anterior and posterior nerves may be distinguished with reference to the course which they pursue. The anterior nerves, which are of greater diameter than the posterior

ones, varied in number in the two specimens sectioned. In the one, two nerves arise from the dorso-lateral margin of the ganglion, and may be traced cephalad for a number of sections; they diverge only slightly; in the other specimen there is, in addition to the two lateral anterior nerves, also an unpaired median nerve of greater diameter than the other two, which bifurcates at its anterior end. The posterior nerves arise a couple of sections behind the anterior ones, and are two in number (one on each side of the median line), though in one of the specimens there appeared to be two on one side and one on the other; these posterior nerves pass caudad, diverging in their course, and may be traced into the lateral tail lobes, where they divide into still smaller nerves.

In one male sectioned an elongated cuticular penis was present in the cloaca, this being only the second case of a penis being observed in a Gordiid, the other case having been observed by Vejdovsky. But the description of these interesting anatomical details must be postponed to a later paper.

12. *Paragordius varius* (Leidy).

Figs. 78-85, Plate 11; Figs. 86-93, Plate 12.

Gordius varius Leidy, '51, '56, '58.

G. varius Leidy, Diesing, 1861.

G. gratianopolensis Charvet, Schneider, '66.

G. varius Leidy, Villot, '74.

G. trilobus Villot, Oerley, '81.

G. varius Leidy, Camerano, '93.

Chordodes varius Leidy, Römer, '96.

(Leidy's original type specimens have apparently not been preserved.)

Form of the Female. The anterior and posterior portions of the body are narrower than the middle, the decrease in diameter being very gradual; the anterior is narrower than the posterior end. The head end (Figs. 83-85) is obliquely truncated in such a way that the antero-ventral margin projects farther forward than does the antero-dorsal; this truncated plane, which forms the terminal aspect of the head, is very nearly flat. The mouth lies near the ventral edge of the truncated plane. The posterior end (Figs. 88-90) is trilobed, there being one dorso-median and two latero-ventral lobes; these lobes have no cuticular spines on their surface, and in the great majority of the numerous specimens examined are of equal length. Two specimens in the Harvard collection were exceptions to this equality in length: in one the dorsal lobe was slightly longer than the others, in the other slightly shorter. But the dorsal lobe is narrower than the others, and further differs from the latter in having an elevated median ridge on its ventral surface, so that on cross section it appears triradiate (Figs. 80, 81). The lateral lobes are crescent-shaped on cross section. The cloacal aperture, wholly hidden by these lobes, lies at their base and between them, so that the cuticle and epidermis of the inner surface of the lobes are directly continuous with the cuticle and epithelium of the

cloaca (Fig. 86). The lobes may be either parallel or divergent, and hence are probably movable.

Form of the Male. The anterior end (Fig. 82) as in the female, but the body more slender. The tail lobes (Fig. 87) are comparatively long and slender, cylindrical in shape, and obtusely rounded terminally. Small conical spicules occur on the medio-ventral surfaces of the anterior half of the lobes, and short hairs on their anterior surfaces. The elongate cloacal aperture lies in the medio-ventral line of the body, anterior to the tail lobes.

Cuticle. On cross section (Fig. 91, *a*) an outer thin hyaline layer is seen, and an inner, much thicker fibrous layer. Embedded in the hyaline layer are small lozenge-shaped bodies, which stain more deeply than any other portion of the cuticle, and which correspond to the areolæ seen on surface views. The external surface of the hyaline layer of the cuticle is marked by short conoidal processes of the same structure as the hyaline matrix; these are not seen on surface views. On surface view (Figs. 91, *b*-93) the cuticle appears areolated: the areolæ are small, variable in size and form, and irregularly arranged. Sometimes they occur in groups, sometimes in interrupted longitudinal rows; their arrangement varies both in different individuals as well as on different portions of the same individual. The areoles are irregularly polygonal in outline. In one female larger brown-colored areoles were present in addition to the smaller, lightly colored ones; the former were mainly arranged in the form of longitudinal ridges, and were irregularly star-shaped in outline.

Color. Color usually lighter in the females than in the males, varying from a light brown or yellowish to a dark brown (the larger individuals usually darker). The tip of the head is white or a pale brownish; just behind there is a dark ring of color, usually rusty brown or even black, rarely pale; this ring is darkest at its anterior edge, and darker on the dorsal than on the ventral side of the body. At least a trace of this ring is to be seen on all specimens when mature, though the intensity of its coloration is very variable.

Dimensions. Length of largest male seen, 350 mm.; greatest diameter, .9 mm. Length of largest female, 290 mm.; greatest diameter (of a flattened individual), 2 mm. The males are more slender and average considerably shorter than the females.

Especial Diagnostic Characters. The trilobation of the posterior end of the female, the long and cylindrical tail lobes of the male, the oblique truncation of the head end, and the usually very dark colored ring around the head, render this species very easy of identification.

Comparisons. This species has the greatest affinity to *Gordius* (*Paragordius*?) *tricuspidatus* (Dufour); but it differs from it in that there are no spicules or spines upon the tail lobes of the female, and in that the dorsal is narrower than the lateral lobes; further, in *varius* the areoles of the cuticle are frequently arranged into rows or groups.

Geographical Distribution. I have examined specimens from the following localities: New York, Maine, Massachusetts, New Jersey, Pennsylvania, Virginia, Kansas, California, and Guatemala; and it has been observed by others

in Mexico, Peru, and Bolivia. It appears to have a very extensive range, and it and *G. aquaticus robustus* are the most abundant forms in the northeastern portion of the United States.

Genus **CHORDODES** (Creplin) Möbius.

13. *C. morgani*, n. sp.

Fig. 94, Plate 12; Figs. 95-100, Plate 13.

(1 female, type, in my possession, from Maryland; a second female from Iowa in the Harvard coll. no. 1470.)

Description of the Type Specimen. *Form:* Perfectly cylindrical without median lines. Anterior end gradually attenuated, head (Fig. 98) much narrower than the posterior end, rounded. Tail end (Fig. 97) swollen, obtuse posteriorly, the swelling most pronounced on the ventral aspect. *Cuticle:* With three kinds of prominences (Figs. 99, 100): (1) Larger tubercles which are about twice as high as broad, nearly circular on cross section, and rounded apically; these bear no hairs, and are distributed at nearly equal distances on the surface of the cuticle, with only a slight tendency to arrange themselves into disjointed groups. (2) Smaller tubercles, which are pointed at the apex and more or less conical in form; these vary considerably in height, but are never more than a quarter the height of the preceding kind. Each bears on its summit a single delicate hair. These tubercles are arranged quite densely on the surface of the cuticle, and the larger ones among them are grouped closely around the tubercles of the 1st order; in the median line of the body they are more numerous, especially the larger ones of them, which form groups between as well as around the tubercles of the 1st order. (3) Delicate slender hyaline processes, frequently club-shaped, which occur only sparsely, and are a little higher than the first kind of tubercles. *Color:* A uniform yellowish brown. *Dimensions:* length, 222 mm.; greatest diameter of body, 1.1 mm.

Description of the Second Specimen. *Form:* Anterior end pointed, and head tip (Fig. 94) rounded as in the preceding, but on the ventral surface of the head, to each side of the median line, is a short longitudinal groove. Body nearly cylindrical, with narrow but deep median grooves; on a portion of the surface there are likewise irregular longitudinal grooves. Posterior end (Figs. 95, 96) swollen, though of less diameter than the body at its middle point; this distal swelling is of greater diameter than the dorso-ventrally flattened portion of the body which immediately precedes it. The posterior end is truncated terminally, and near the centre of this terminal aspect (Fig. 96) is situated the cloacal aperture at the middle point of a vertical ridge, to each side of which is a groove. On the dorso-lateral sides of the posterior end larger and deeper grooves are situated. *Color:* A uniform dull chocolate-brown, the terminal aspect of the head somewhat lighter in color.

Cuticle: as in the preceding specimen. *Dimensions*: length, 158 mm.; greatest diameter of body, 9 mm.

Especial Diagnostic Characters. The peculiarities of the cuticular tubercles, and the uniform coloration.

Comparisons. The papillæ of the cuticle have some resemblance to those of *C. hamatus* Römer, from West Africa. But the arrangement and form of the papillæ of the latter form is not quite the same, judging from Römer's ('96) description of them: "Die Haut ist mit Papillen bedeckt von der Form kleiner Hügel und spitzer Zacken. Sie sind ganz niedrig; ihre Form ist nicht gleichmässig, auch ihre Entfernung von einander nicht die gleiche, aber sie haben im allgemeinen denselben Habitus. . . . Kopfende des Weibchens stark zugespitzt."

Thus far only two specimens observed, from Iowa and Maryland, respectively.

I have the pleasure of naming this species in honor of my friend Dr. Thos. H. Morgan, of Bryn Mawr College, who kindly gave me the first specimen seen.

14. *C. puerilis*, n. sp.

Figs. 101-105, b, Plate 13.

(*Type*, 1 male: Leidy coll. no. 5071, from a cockroach. A second male secured by me in Chester County, Pennsylvania.)

Form. Anterior portion of the body more slender than the posterior. Head end (Figs. 101, 102) dorso-ventrally flattened, obliquely truncated terminally, mouth opening terminal. Middle and posterior portions of the body horizontally flattened in the larger specimen, cylindrical in the smaller. Posterior end of the body (Fig. 103) narrower than the preceding part, almost cylindrical, terminally rounded; a median groove is present on its ventro-terminal end, and to each side of this groove the integument forms a slightly elevated ridge.

Cuticle. With four kinds of prominences (Fig. 105, b): (1) the largest tubercles, usually of a rounded-conical shape, but vary somewhat in length (the length is usually one third greater than the largest diameter, which is at the base). On the rounded apex occur short, rather thick hairs, terminally pointed, from 5 to 10 hairs to each tubercle. (2) Long hyaline, slender processes, which vary considerably in form, but are usually either finger-shaped or club-shaped; these are the highest and least abundant of all cuticular prominences, and are devoid of hairs. (3) These most abundant tubercles are usually conical in shape, and from one fourth to one half the length of the first kind; each bears on its summit a single strong hair, which is slightly longer than the hairs of the 1st kind of tubercles. (4) The smallest tubercles are not quite as high as the preceding kind, are hemispherical, and without hairs. On surface views of the cuticle (Figs. 104, 105, a) the various kind of tubercles are seen to be closely arranged together, without any regular distribution into groups. All these tubercles are very small, and may be distinguished clearly only on thin sections studied with the $\frac{1}{12}$ immersion lens of Zeiss.

Color. A more or less deep chocolate-brown, somewhat lighter on the anterior end; head (not merely its terminal tip) almost white.

Dimensions. Length of the larger individual, 212 mm.; greatest diameter of body, 1 mm.

Special Diagnostic Characters. The three kinds of minute papillæ, which are not arranged into particular groups, furnish the chief diagnostic character.

Comparisons. This species differs in the characters of its cuticle from all foreign species of the genus. These characters appear to resemble those described by Camerano ('97, *b*) for *C. talensis*; but the description of this author is difficult to understand, and is without figures, so that it seems justifiable to class our species as new, at least until further descriptions and figures of *talensis* are published.

15. *C. gordioides*, n. sp.

Figs. 106, 107, Plate 13; Figs. 108-110, Plate 14.

(*Types*, males and 1 female: coll. Acad. Nat. Sci. Phila., Hayden's Survey, S. Montana.)

Form of Male. Anterior end slender, cylindrical, attenuated, head (Fig. 108) somewhat conical with obtusely truncated tip; mouth terminal. Body for the most part cylindrical, without well marked median grooves; thickest in the posterior fourth. Posterior end, for the distance of 10 mm., considerably narrower than the immediately preceding portion, and slightly flattened dorso-ventrally. Cloacal aperture on the ventral surface (Fig. 110), anterior to the posterior tip of the body; just anterior to this aperture is a slightly elevated semilunar ridge. In the medio-ventral line of the body, behind the cloacal aperture, is a shallow groove, to each side of which is a longitudinal prominence. The posterior end of the body is rounded terminally.

Form of Female. General form as in the male, the body thickest in the middle, narrowed anteriorly, more or less flattened posteriorly. Posterior end (Fig. 109, *a, b*) enlarged, somewhat spherical, constricted off from the immediately preceding portion of the body; cloacal aperture terminal, nearer the dorsal than the ventral side.

Cuticle. With low flattened tubercles, but little higher than the areolæ of *Gordius densarcolatus*. On surface views (Fig. 107) these appear small, ovoid or rounded-polygonal in outline, but they vary considerably in shape and somewhat in size, and are often much elongated. They have a tendency to arrange themselves into parallel rows, contiguous rows being well separated from one another; the direction of these rows is slightly oblique to the transverse axis of the body, and their component tubercles are more or less confluent. Light colored lines also are seen on the surface of the cuticle, the distances which separate these lines being variable; these lines, the optical representations of shallow grooves, demarcate rhomb-shaped portions of the cuticle. On cross sections (Fig. 106) the tubercles are seen to be low, and usually flattened apically, with

rounded margins; occurring at intervals, but sparsely, are club-shaped slender hyaline processes such as are characteristic of the genus, and these are about double the height of the tubercles; and also small inter-tubercular groups of short, spiniform hairs.

Color. In the males the head is yellowish white, with a narrow black ring (appearing like a spot) immediately around the mouth; the rest of the body a deep chocolate-color, or rufous-brown, with evidences of lighter brown bands and spots on the posterior end, though these spots were absent in one individual; in the smallest male the body color was a clear yellowish brown. In the single female specimen a black ring immediately surrounded the mouth opening; but the rest of the body is a clear yellow, the head and posterior tip of the body somewhat lighter.

Dimensions. Length of largest male, 215 mm.; greatest diameter, 1.3 mm. Length of female, 150 mm.; greatest diameter, .8 mm.

Diagnostic Characters. The presence of flattened tubercles, resembling the cuticular areoles of the genus *Gordius*, none of which have a light spot on the surface, and which tend to arrange themselves into irregular oblique rows, and the presence of inter-tubercular groups of small hairs, serve to distinguish this species.

Comparisons. This species resembles most closely *C. occidentalis*, n. sp. (*q. v.*). It also bears some resemblance to *C. moluccanus* Römer ('96), but differs from the latter in the form and more especially the arrangement of the tubercles of the cuticle, and in the swelling of the posterior end of the female.

The cuticle of this species resembles that of a *Gordius* rather than that of a *Chordodes*, except that it shows the typical hyaline processes of the latter genus; and since its cuticle thus unites characters of these two genera, the specific name *gordioides* is suggested.

16. *C. occidentalis*, n. sp.

Figs. 111-114, Plate 14; Figs. 115-117, Plate 15.

(*Type* 1 male: Harvard coll. no. 1469, San Francisco, Cal. A second male: Harvard coll. no. 1481, Rio Gila, Arizona.)

Form. Whole body much flattened dorso-ventrally, with the exception of the posterior end, in the type without, in the second specimen with, shallow median grooves; anterior and posterior ends narrower than the middle portion of the body, though the anterior end is attenuated only for a distance of about 1 cm. Head (Figs. 111, *a, b*) flattened, conical, the tip rounded or else obtusely truncated, and then the dorsal margin projects farther forward than does the ventral. Mouth terminal. In the second specimen (Figs. 114, *a, b*) a Y-shaped ridge is situated on the terminal aspect of the head, the mouth placed at the point of union of the three arms of the Y; the unpaired arm of this Y-shaped ridge runs from the mouth medially and dorsally, the paired arms latero-ventrally.

Posterior end of the body is nearly cylindrical, somewhat flattened ventrally, and terminally either rounded or obliquely truncated. On the medio-ventral surface of the posterior end (Figs. 112, 113, *a*, *b*) is a shallow groove, which extends from the cloacal aperture caudad to the distal end of the body, and to each side of this groove is a longitudinal ridge of slight elevation.

Cuticle. On surface view (in Canada balsam) two kinds of low, flattened tubercles or areoles are to be seen (Figs. 115, 117): (1) The larger (those of greater diameter) are darker in color, and either elongate (in one specimen) or rounded-polygonal in outline. In the median line of the body they are smaller and more densely arranged than elsewhere. In one specimen (the type, Fig. 115) these areoles were non-confluent; but in the other they show a tendency to group themselves in interrupted, transverse rows, and consequently are more elongate in form than in the former (type) specimen. On the surface of some of the larger areoles is seen a small, circular clear spot, in the centre of which appears a small granule; sections show that this spot is a pit on the surface of the tubercle, which is nearly filled with a small rounded-conical process; those tubercles on the lateral surfaces of the body which contain such clear spots, and they are few in number, are usually dumbbell-shaped in outline, and their clear spots are smaller than those of the median tubercles, in which they occur more frequently. (2) Smaller, lighter colored tubercles, much more variable in form and size than the preceding, and which are irregularly arranged between the former kind. In one of the specimens a system of oblique lines is seen on the surface of the cuticle, and these lines are peculiar in that they do not lie between rows of areoles, but appear to run right across their surface (Fig. 117).

On transverse section of the cuticle two kinds of tubercles are seen, corresponding to the two kinds seen on surface views (Fig. 116): (1) Low tubercles of greater diameter, which are flattened apically, and have no projections. (2) Tubercles of smaller diameter, very irregular in form, and usually of slightly less elevation than the preceding; these correspond to the smaller, lighter tubercles seen on surface views. The apex of these is not flattened, but more or less irregularly rounded; from the summit project upwards short conical or spiniform processes, which are exceedingly variable in form, sometimes cleft or pectinate terminally, though most of them are largest at the base and pointed at the apex. Rarely is there only a single process to a tubercle: as a rule there are a number, and on the tubercles of the dorso-median line of the body they are more numerous than elsewhere. In addition to these two kinds of tubercles are seen on sections, though only sparsely, hyaline club-shaped processes.

Color of type specimen: black, at the anterior end of the body with a reddish tinge; the tip of the head yellowish white. The second specimen was of a deep rufous-brown color, lighter at the anterior tip of the body, and blackish at the posterior end.

Dimensions. Length of larger individual (type), 255 mm.; greatest diameter, 1.5 mm.

Especial Diagnostic Characters. The presence of two kinds of slightly elevated tubercles on the cuticle : tubercles of greater diameter with smooth summit, a few of which have an apical clear spot ; and tubercles of smaller diameter and usually less elevation, the surface of which is not smooth, but with more or less numerous conical or spiniform short processes.

Comparisons. This species is more closely allied to *C. gordioides* than to any other, but differs from it in the following points : the presence of tubercles whose surface bears short processes, the presence of clear spots on the surface of some of the smooth tubercles, and the absence of groups of inter-tubercular hairs ; there are also differences in coloration, such as the absence of a black ring around the mouth aperture, and the much darker color of the body.

17. *C. cubanensis*, n. sp.

Figs. 118-123, Plate 15.

(*Type of Female* : Harvard coll. 1466, Cuba. *Type of Male* : Harvard coll. 1466 d, Cuba.)

Form of Male. Body nearly cylindrical, without well marked median grooves ; anterior end slightly attenuated. Head (Fig. 123) very narrow, truncated apically, slightly concave on the terminal aspect ; on the ventral surface alone is there a constriction separating the head from the body. Posterior end (Fig. 122) flattened on the ventral surface, with a median groove behind the cloacal aperture ; this groove is broadest and deepest at the ventro-terminal point of the body ; just behind the cloacal aperture is a transverse semilunar ridge.

Form of Female. Larger and more robust than the male, the shape of the anterior portion of the body otherwise similar. Head (Fig. 120) rounded at the apex, mouth nearer the ventral than the dorsal margin of the head. Posterior portion of the body (Fig. 121) narrower than the middle, but the extreme distal end is swollen, and of greater diameter than the part immediately preceding. This posterior end is obliquely truncated, the dorso-terminal margin projecting farther caudad than the ventro-terminal ; the swelling is most pronounced on the ventral side.

Cuticle (Fig. 119). With papillæ of three kinds, besides hyaline processes ; though it is difficult to distinguish sharply between these kinds since they seem to intergrade. The hyaline processes have the same form as in most other species of the genus, and are slender club-shaped processes, slightly swollen and rounded at the apex ; they are about the height of the highest papillæ. *1st Kind of Papillæ* : The smallest, least elevated, and most numerous of all occur close together between the groups of larger papillæ, and also in the latter groups. They are pyramidal or somewhat elongate-conical on lateral view, pointed at the apex which bears a single (rarely two) long, delicate, usually curved spine ; this spine is thickest at the base and sometimes recurved at the tip. A modification of these tubercles attains nearly the height of the largest papillæ. *2d Kind of Papillæ* : These, the second in point of

numerical abundance, occur usually in groups close together. They are much larger than the preceding, round on cross section, usually considerably longer than broad, slightly thickened at the base but with nearly parallel sides, and with rounded summit. In a few cases the sides of these papillæ may be somewhat denticulate. On the margin of the rounded or flattened apex occur from three to six short thick spines, which are broadest at the base and pointed at the tip; these spines curve upwards and outwards, and are shorter and thicker than those of the preceding category of papillæ. These papillæ vary considerably in form, and sometimes are nearly square in lateral outline. *3d Kind of Papillæ:* These are of the same form and size as the preceding, but are less numerous (the groups which they compose are smaller), and differ from them in the absence of spines on their summits; the apex of most of them is elliptically rounded, rarely flattened, and then somewhat denticulate with short conical processes; some of these papillæ are expanded at the summit.

On surface views (Fig. 118) of the cuticle, seen with a low power of magnification, only the second and third kinds of papillæ are seen, and they appear as small brown disks with a clearer central point. The cuticle of the male differs from that of the female only in that the larger kinds of papillæ are less abundant, and the groups formed by them smaller.

Color. The males are uniform pitch-black, the head somewhat lighter; in the female the whole body is deep black.

Dimensions. Length of largest male, 165 mm.; greatest diameter, 1 mm. Length of female, 280 mm.; greatest diameter of body, 1.6 mm.; greatest diameter of tail swelling, 1 mm.

Especial Diagnostic Characters. The dense arrangement of the usually pencil-shaped papillæ, and the union of the larger of them into large and irregular groups, together with the black color of the body, serve to distinguish this form.

Comparisons. In color this species resembles *C. brasiliensis* Janda, and *C. festæ* Camer.; but it differs from the former as well as from *C. morgani*, n. sp., in the form and arrangement of the papillæ. In the structure of the cuticular papillæ it also differs from *festæ*, judging from Camerano's description: but unfortunately most of the South American *Gordiacea* described by this author have not been figured, and for a clear understanding of the form and arrangement of areoles and papillæ figures are absolutely necessary.

POSTSCRIPT.—The preceding descriptions of body form, color, and dimensions have been based entirely upon a study of alcoholic specimens, with the consequence that the particulars in regard to coloration and dimensions could be only approximately ascertained, since the action of the alcohol would probably produce shrinkage, and certainly obscures the brightness of the coloration. Formaline would probably be a superior fluid for the preservation of museum specimens. For purposes of histological fixation rapidly penetrating fluids are necessary, such as picro-formaline or picro-nitric acid.

APPENDIX.

Since the preceding was sent to press (on the 16th August, 1897) I have received from Professor Camerano the following important contribution by him: "Monografia dei Gordii" (Accademia Reale delle Scienze di Torino, 1897). This paper furnishes descriptions and revisions of all known species of Gordiacea, with illustrations of all those described by Camerano, and is especially valuable on this account from the systematic standpoint. To the already known genera *Gordius* and *Chordodes*, this author adds two others, namely, *Paragordius* and *Parachordodes*. *Paragordius* embraces, according to Camerano, *G. tricuspидatus* (Dufour), *G. emeryi* Cam., *G. stylosus* Linstow, and *G. varius* Leidy. He characterizes it as follows: "L'estremità posteriore del ♂ è biforcata al di là dell'apertura postcloacale con lobi profondamente separati fra loro: non vi è lamina cutanea postcloacale. L'estremità posteriore della ♀ è divisa in tre lobi postcloacali profondamente separati fra loro i quali circondano l'apertura cloacale. Lo strato cuticolare esterno presenta delle formazioni areolari di una sola serie e pochissimo sporgenti, irregolarmente disposte: non vi sono granuli o tubercoli rifrangenti interareolari." By an unusual coincidence, I had in the preceding pages proposed the same name, *Paragordius*, to include Leidy's species *Gordius varius*, so that independently of one another Camerano and I have founded a new genus, and given it the same name for the same species. By the rules of priority in nomenclature, however, Camerano's publication having appeared first, the genus must stand *Paragordius* Camerano, not Montgomery. But the diagnostic given by Camerano for this new species is not very well chosen, for in it the only character of possible genetic value mentioned is the trilobation of the posterior end in the female; this character is of doubtful generic value, since in *Gordius tolosanus* Duj. the posterior end of the female is somewhat lobed, though in this case the lobation is generally regarded as only a specific character! I think the characters described above by me as diagnostic of the new genus, — namely, the structure of the cloaca in the female and the absence of a cloacal musculature in the male, — are of higher value, and accordingly should constitute the diagnostic of the genus. The second new genus of Camerano is characterized thus (*Parachordodes*): "Estremità posteriore del ♂ biforcata al di là apertura cloacale, con lobi profondamente separati fra loro: nessuna lamina-cutanea postcloacale. L'estremità posteriore della ♀ è intiera coll'apertura cloacale mediana collocata in un solco dorso ventrale più o meno profondo. Strato cuticolare esterno meno

complicato che nel genere *Chordodes*: ora con una sola sorta di formazioni areolari, ora con formazioni areolari di due sorta: le une più basse e chiare: e le altre un po' più elevate e scure che stanno intorno allo sbocco dei canaletti che attraversano gli strati cuticolari: fra le areole spesso vi sono granuli o tubercoli rifrangenti." *Parachordodes* thus differs from *Gordius* merely in regard to cuticular structures, and I cannot consider that such differences warrant the separation of a new genus. For in the Gordiacea the cuticular differences have little more than specific value, as is well shown by the fact that the cuticle may show marked differences in different individuals of the same species. If more important differences than these be subsequently determined, then, and not until then, does it seem justifiable to me to recognize *Parachordodes* as a well defined genus; and hence it should for the present be retracted into *Gordius*. (A preliminary to this monograph was published by Camerano in the Zool. Anzeiger for August, 1897, with the title "Nuova classificazione dei Gordii.") In this paper are given figures of the cuticle of *Chordodes talensis* Cam., which represent its structure as quite different from that of my new species, *C. puerilis*.

Here may also be mentioned certain papers on American Gordiacea which had been omitted in the preceding pages.

Girard (1851, "Historical Sketch of Gordiacea," Proc. Acad. Nat. Sci. Philadelphia, 5) mentions a specimen caught at Richmond, Virginia, and several collected in Oregon by the U. S. Exploring Expedition.

Sanford (1853, "On some Points in the History of *Gordius*," Proc. Amer. Assoc. Sci.) collected some specimens from crickets (*Gryllidæ*).

Thompson (1853, "History of Vermont," Burlington) states that *Gordii* are very common in still waters and mud in that State.

White (1859, "*Gordius trifurcatus*, n. sp.," Proc. Boston Soc. Nat. Hist., 7) gives the following description of this species, which may possibly be referable to the ♀ of *Paragordius varius* (Leidy): "Male. Length, 5 inches; diameter, $\frac{1}{8}$ line; shape uniformly cylindrical; head obtusely conical; posterior end divided into two long and narrow lobes, and one shorter and broader lobe, incurved and fringed with short thick hairs. At base of larger lobe is the genital opening, from which the spermatozoa are seen escaping with extremely long tails. Color uniformly light brown. . . . It does not answer to either of the two described by Dr. Leidy."

Clementi (1869, "Hair Snakes," Canadian Entomologist) found *Gordii* (?) in a large spider.

Leidy (1870, "The *Gordius*, or Hair-worm," Amer. Entomol. and Botanist, 2) gives a good description and some figures (the only figures published by him of members of this group) of his *G. varius*. He considers the males of this form, as previously described by him, to be really of two different species: in the one (*varius*) the forks of the tail are thick, with a crescentic fold above the genital pore. In the other males (*G. longilobatus*, n. sp.) "the forks of the tail are two or three times the length of the thickness of the body, and the forks do not include at their base a crescentic fold as in the former." (The male here

termed "*varius*" is really *G. aquaticus robustus*, while "*longilobatus*" is the true *Paragordius varius*.)

Leidy (1871, "Notice of some Worms," Proc. Acad. Nat. Sci. Philadelphia) describes as "*Gordius lacustris*" several specimens from Kansas; but "*lacustris*" is certainly a misprint for "*robustus*," since the papers to which he refers for the preceding name make no mention of it.

Garman (1886, "Amblystoma and Gordius," Science Observer, Boston Sci. Soc., cited by Camerano) mentions a *Gordius* found in *Amblystoma*.

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EXPLANATION OF THE PLATES.

All the figures have been drawn with the aid of the camera lucida, unless otherwise specified. The microscope and lenses of Zeiss were used; almost all the contour figures of the body have been drawn with oc. 2, obj. A; and the majority of the surface figures of the cuticle with oc. 4, obj. C.

PLATE 1.

Gordius aquaticus robustus.

- Fig. 1. Male, ventral view of posterior end (A, 4).
- Fig. 2. Idem, head end (A, 2).
- Fig. 3. Male, oblique ventral view of posterior end (Harvard coll. 290, A, 2).
- Fig. 4. Lateral view of the preceding, from the left side.
- Fig. 5. Male, ventral view of posterior end (A, 2).
- Fig. 6. Male, ventral view of head end; the transverse curved line shows the posterior extension of the white area (A, 2).